WATER RESOURCES REPORT 8

WATER POSSIBILITIES FROM THE GLACIAL DRIFT OF DE KALB COUNTY

BY

DALE L. FULLER
J. R. McMILLEN
HARRY PICK
and
W. B. RUSSELL

MISSOURI GEOLOGICAL SURVEY AND WATER RESOURCES

Water Resources Report 8

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Dale L. Fuller, J. R. McMillen, Harry Pick
and W. B. Russell

1957

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Division of
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WATER POSSIBILITIES FROM THE GLACIAL DRIFT OF DEKALB COUNTY

A special study of groundwater by the Missouri Geological Survey and Water Resources was made possible at the 1955 session of the Missouri Legislature. With the approval of the Governor, money was appropriated from the Missouri Post War Surplus Reserve Fund.

Since nearly two-thirds of the counties located north of the Missouri River are deficient in water supplies, much of the effort of this special study is being directed toward the problems of this area.

It has been shown that a program of test drilling can locate new reserves of groundwater. Potential areas are being tested so that additional supplies will be available for domestic, irrigation, industrial and municipal needs.

The most favorable areas are in the sand and gravel filled channels and valleys of pre-glacial and inter-glacial streams. Since these buried valleys do not conform to present day drainage patterns, a systematic program of test drilling is a principal means of locating the channels and mapping their extent. Such glacial deposits have proved to be excellent sources of groundwater.

QUALITY OF WATER FROM ROCK WELLS

The water from the consolidated rock formations which underlie DeKalb County is, for the most part, mineralized. The following are analyses from water wells and oil tests:

CONSTITUENTS	IN PARTS PER MILLION				
	A	B	C	D	E
Turbidity	4	turbid	turbid	turbid	turbid
Odor	none	oily	none	kerosene	none
pH	7.9	7.6			
Alkalinity ($CaCO_3$)	384.5	169.5	263.9	679.9	709.0
Phenolpthalein	0.0	0.0			
Methyl Orange	384.5	169.5			
Carbonate (CO_3)	0.0	0.0	12.4	29.2	25.1
Bicarbonate (HCO_3)	469.1	206.8	309.3	799.5	839.1
Silica (SiO_2)	24.3	7.5	2.0	10.8	11.6
Oxides (Al_2O_3, Fe_2O_3, TiO_2, etc.)	1.7	2.0	0.40*	0.70[1]	0.56[1]
Calcium (Ca)	273.0	241.8	4.4	9.0	11.8
Magnesium (Mg)	92.7	115.1	0.5	5.7	7.1
Sodium (Na) and Potassium (K) as Na	165.6	1959.2	152.0	1321.8	1514.6
Total Manganese (Mn)	0.15			0.04	0.05
Total Iron (Fe)	1.36	12.3			
Dissolved Iron	0.04			0.07	0.17
Precipitated Iron	1.32				
Sulfate (SO_4)	837.1	1596.8	3.9	11.9	3.5
Chloride (Cl)	8.5	2583.	36.1	1527.1	1854.4
Nitrate (NO_3)	1.7			0.77	0.0
Fluoride (F)	0.4		0.40	3.00	5.60
Total Suspended Matter	15.				
Total Dissolved Solids	1699.	6942.	402.0	3405.0	3819.0
Total Hardness	1063.3	1077.5	13.1	45.9	58.6
Carbonate Hardness	384.5	169.5	13.1	45.9	58.6
Non-carbonate Hardness	678.8	908.0			
Percent of Alkalies	29	79	99	98	98

* Al_2O_3, Fe_2O_3

[1] Al_2O_3

A. Owner: Fairport School R-6, NE¼ SE¼ SW¼ sec. 26, T. 60 N., R. 31 W. Total depth 136 feet of which approximately 90 feet were in glacial drift. Static water level approximately 50 feet. Water sample from pressure tank collected November 8, 1956. Analyst: M. E. Phillips.

B. Owner: Walter Chenault, et al., Glen Dice farm, NE¼ SE¼ sec. 2, T. 58 N., R. 30 W. Total depth 1341 feet, bottomed in the Devonian System. Water sample from the Mississippian System by bailer before setting casing at 1293 feet. Collected September 8, 1952. Analyst: M. E. Phillips.

C. Owner: George Karl, SE¼ SE¼ sec. 23, T. 58 N., R. 33 W. Total depth 500 feet plus. Sampled by lowering pipe into hole. Formational source cannot be determined from driller's log. Collected April 20, 1939. Analyst: R. T. Rolufs.

D. Owner: George W. Moore, et al, C. H. McQuate farm, NE¼ SW¼ SW¼ sec. 11, T. 57 N., R. 31 W. Total depth 1490 feet, bottomed in the Devonian System. Sample from depth interval 322 to 327 feet, Galesburg Formation, Kansas City Group of the Pennsylvanian System. Sampled May 1, 1939. Analyst: R. T. Rolufs.

E. As above. Sample from Bethany Falls Member, Swope Formation, Kansas City Group of the Pennsylvanian System 348 to 350 feet. Collected May 4, 1939. Analyst: R. T. Rolufs.

CONSTITUENTS	IN PARTS PER MILLION		
	F	G	H
Turbidity	turbid	turbid	20
Odor	disagreeable		none
pH			8.2
Alkalinity ($CaCO_3$)	346.9	192.6	398.5
Phenolpthalein			28.0
Methyl Orange			370.5
Carbonate (CO_3)	0.0	0.0	16.8
Bicarbonate (HCO_3)	423.1	234.9	452.0
Silica (SiO_2)	3.6	4.4	5.3
Oxides (Al_2O_3, Fe_2O_3, TiO_2, etc.)	1.40[1]	5.60*	0.3
Calcium (Ca)	153.7	141.4	95.8
Magnesium (Mg)	61.2	65.9	46.7
Sodium (Na) and potassium (K) as Na	2464.7	1915.9	1631.9
Total Manganese (Mn)	0.20		0.17
Total Iron (Fe)			3.82
Dissolved Iron	0.70		0.03
Precipitated Iron			3.79
Sulfate (SO_4)	925.1	1214.3	215.6
Chloride (Cl)	3051.7	2334.8	2347.5
Nitrate (NO_3)	0.0		6.2
Fluoride (F)	2.80		0.6
Total Suspended Matter			9.
Total Dissolved Solids	6931.0	5859.0	4589.
Total Hardness	635.2	623.7	431.4
Carbonate Hardness	346.9	192.6	398.5
Non-carbonate Hardness			32.9
Percent of Alkalies	89	87	89

* Al_2O_3, Fe_2O_3

1 Al_2O_3

F. As above. Sample from Ste. Genevieve? Formation, Mississippian System. Depth interval 1029 to 1033. Sampled June 9, 1939. Analyst: R. T. Rolufs.

G. As above. Sample from Keokuk-Burlington formation, Mississippian System. Depth interval 1235 to 1265 feet. Sampled July 22, 1939. Analyst: R. T. Rolufs.

H. Owner: Hugh Swords, NW¼ NE¼ SW¼ sec. 28, T. 58 N., R. 30 W. Total depth 425 feet. Collected directly from the pump November 20, 1956. Temperature of the water 56° F., of the air 32° F. Analyst: M. E. Phillips

Referring to plate 1, it will be noted that a large area of DeKalb County is unfavorably located to obtain water from glacial drift. Wells drilled into the consolidated rock to moderate depths may possibly obtain limited yields of water of marginal quality. The water from "rock" wells in all probabilities will become more mineralized with increased depth of drilling.

QUALITY AND QUANTITY OF WATER FROM STREAMS

The streams of DeKalb County are intermittent in their flow. Though the quality of the water is usually satisfactory, the undependable flow makes all streams unsuitable for irrigation or for municipal use.

There is no water analyses available.

QUALITY OF WATER FROM GLACIAL DRIFT

In general, the water from the glacial drift is high in total iron, total dissolved solids, and sulfates. The iron content in the water may cause staining of plumbing fixtures and laundry; however, relatively inexpensive water treatment for the iron will prevent this staining. For most types of irrigation, total dissolved solids should not exceed 2000 parts per million and total alkalies should not exceed 75 percent. Most people cannot tolerate water for drinking purposes which contains more than 1500 parts per million of chloride, or 2000 parts per million sulfate. Water with 300 parts per million of chloride tastes salty to some people. Sulfates in excess of 500 parts per million may have a laxative effect when first used for drinking.

The following are analyses from eleven glacial drift wells:

CONSTITUENTS	IN PARTS PER MILLION			
	1	2	3	4
Turbidity	50.0	10	turbid	4
Odor		none	musty	none
pH	6.4	8.0		7.5
Alkalinity ($CaCO_3$)	244.0	237.5	374.4	315.5
Phenolpthalein	0	10.0		0.0
Methyl Orange	244.0	227.5		315.5
Carbonate (CO_3)	0	6.0	0.0	0.0
Bicarbonate (HCO_3)	297.7	277.6	456.6	384.9
Silica (SiO_2)	12.0	12.3	10.0	13.7
Oxides (Al_2O_3, Fe_2O_3, TiO_2, etc.)		0.7	0.99*	1.3
Calcium (Ca)	56.8	100.8	24.4	192.9
Magnesium (Mg)	19.0	37.9	9.3	83.8
Sodium (Na) and Potassium (K) as Na	18.6	288.8	146.0	168.8
Total Manganese (Mn)		0.00		0.32
Total Iron (Fe)	8.0	1.38	5.30	0.89
Dissolved Iron		0.05	0.20	0.05
Precipitated Iron		1.33	5.10	0.84
Sulfate (SO_4)	0.4	683.1	20.0	820.6
Chloride (Cl)	12.7	52.0	18.1	9.3
Nitrate (NO_3)	0.44	6.8	7.38	0.2
Fluoride (F)		0.8		0.6
Total Suspended Matter		0.	129.2	0.
Total Dissolved Solids	314.0	1389.	516.0	1615.
Total Hardness	220.0	407.7	99.1	826.6
Carbonate Hardness	220.0	237.5	99.1	315.5
Non-carbonate Hardness	0	170.2		511.1
Percent of Alkalies	15	61	76	31

* Al_2O_3

1. Owner: City of Union Star. No well data available but presumably the source is from alluvium or from glacial drift. Sample collected direct from well number 1 September 19, 1956. Analyses by the Division of Health of Missouri.

2. Owner: Milton M. Pottratz, SW¼ SE¼ SE¼ sec. 28, T. 60 N., R. 32 W. Total depth 165 feet bottomed in glacial drift. Static water level 40 feet. Collected November 20, 1956 after passing through the pressure tank. Analyst: M. E. Phillips.

3. Owner: U. L. McCartney, NW¼ SW¼ sec. 7, T. 58 N., R. 31 W. Total depth 298 feet. Analyzed September 30, 1935 by R. T. Rolufs.

4. Owner: Homer H. Hill, SE¼ NE¼ NW¼ sec. 6, T. 59 N., R. 30 W. Total depth 112 feet. Static water level 70 feet. Collected November 20, 1956 after passing through the pressure system. Analyst: M. E. Phillips.

CONSTITUENTS	IN PARTS PER MILLION			
	5	6	7	8
Turbidity	slight	turbid	slight	slight
Odor	none	none	none	none
pH				
Alkalinity ($CaCO_3$)	278.8	309.0	411.1	304.7
Phenolpthalein				
Methyl Orange				
Carbonate (CO_3)	9.7	20.2	0.0	0.0
Bicarbonate (HCO_3)	340.0	376.8	501.3	371.6
Silica (SiO_2)	11.6	6.8	2.8	17.6
Oxides (Al_2O_3, Fe_2O_3, TiO_2, etc.)	1.46*	none*	0.99*	0.73*
Calcium (Ca)	67.4	32.5	35.9	92.5
Magnesium (Mg)	32.4	6.5	10.7	31.5
Sodium (Na) and Potassium (K) as Na	240.0	138.9	145.2	116.4
Total Manganese (Mn)	0.01			
Total Iron (Fe)	2.60	13.68	2.45	1.45
Dissolved Iron	0.10	0.50	0.15	0.05
Precipitated Iron	2.50	13.18	2.30	1.40
Sulfate (SO_4)	444.4	50.4	11.5	184.1
Chloride (Cl)	47.0	22.7	12.1	78.1
Nitrate (NO_3)	2.58	0.28	11.07	4.25
Fluoride (F)	1.0			
Total Suspended Matter	20.0	623.2	47.6	8.0
Total Dissolved Solids	1035.0	543.0	520.0	738.0
Total Hardness	301.3	107.9	133.6	360.4
Carbonate Hardness	278.8	107.9	133.6	304.7
Non-carbonate Hardness				
Percent of Alkalies	63	74	70	41

* Al_2O_3

5. Owner: J. S. Lytle, SE¼ SE¼ sec. 36, T. 59 N., R. 32 W. Total depth 193 feet. Analyzed November 1, 1935 by R. T. Rolufs.

6. Owner: City of Maysville well number 1, sec. 34, T. 59 N., R. 31 W. Total depth 132 feet. Analyzed September 22, 1934 by R. T. Rolufs.

7. Owner: Thomas Thompson, NE¼ SE¼ sec. 13, T. 58 N., R. 32 W. Total depth 298 feet. Analyzed October 11, 1935 by R. T. Rolufs.

8. Owner: Paul Fisher, SW¼ SW¼ sec. 26, T. 58 N., R. 33 W. Total depth 266 feet. Sample collected July 11, 1935. Analyst: R. T. Rolufs.

CONSTITUENTS	IN PARTS PER MILLION		
	9	10	11
Turbidity	10	2	turbid
Odor	none	none	none
pH	8.0	7.9	
Alkalinity ($CaCO_3$)	358.5	371.5	314.1
Phenolpthalein	24.0	0.0	
Methyl Orange	334.5	371.5	
Carbonate (CO_3)	14.4	0.0	0.0
Bicarbonate (HCO_3)	408.1	453.2	383.0
Silica (SiO_2)	14.4	20.8	22.4
Oxides (Al_2O_3, Fe_2O_3, TiO_2, etc.)	1.2	0.6	1.06*
Calcium (Ca)	38.9	71.3	117.5
Magnesium (Mg)	14.0	22.9	40.4
Sodium (Na) and Potassium (K) as Na	112.1	80.5	64.8
Total Manganese (Mn)	0.00	0.00	
Total Iron (Fe)	1.72	0.86	
Dissolved Iron	0.06	0.04	0.10
Precipitated Iron	1.66	0.82	
Sulfate (SO_4)	15.6	35.3	264.4
Chloride (Cl)	3.5	8.0	5.5
Nitrate (NO_3)	6.7	5.2	2.82
Fluoride (F)	0.2	0.2	
Total Suspended Matter	6.	11.	
Total Dissolved Solids	422.	468.	916.0
Total Hardness	154.7	272.3	459.4
Carbonate Hardness	358.5	371.5	314.1
Non-carbonate Hardness	0.0	0.0	
Percent of Alkalies	61	39	23

* Al_2O_3

9. Owner: Stanley Faul, SW¼ SW¼ SW¼ sec. 22, T. 58 N., R. 32 W. Total depth 245 feet. Static water level 145 feet. Sampled after passing through pressure system November 21, 1956. Analyst: M. E. Phillips.

10. Owner: City of Stewartsville, NE¼ SW¼ SW¼ sec. 16, T. 57 N., R. 32 W. Total depth 98 feet 6 inches. 14 gallons per minute yield. Temperature 56° F., air 35° F. Sampled direct from pump November 20, 1956. Analyst: M. E. Phillips.

11. As D in description of "rock" wells. Collected April 11, 1939 from depth intervals 35 to 60 feet. Analyst: R. T. Rolufs.

QUANTITY OF WATER FROM GLACIAL DRIFT

DOMESTIC WELLS.-- included in this category are wells developed for household or general farm use. Yields required from domestic wells vary but seldom exceed 15 gallons per minute. In some parts of Dekalb County sands and gravels were not deposited in the glacial drift. There are also areas where the glacial drift cover is relatively thin or lacking. In such areas the possibility of developing wells is limited. Plate 1 shows the area most favorable for the development of domestic wells. Plate 3 is a contour map showing the elevation of bedrock above sea level. To determine probable drilling depths, the elevation of the bedrock should be subtracted from the surface elevation of each specific site. Plate 3 shows the locations of the test holes and the thickness of the glacial drift encountered.

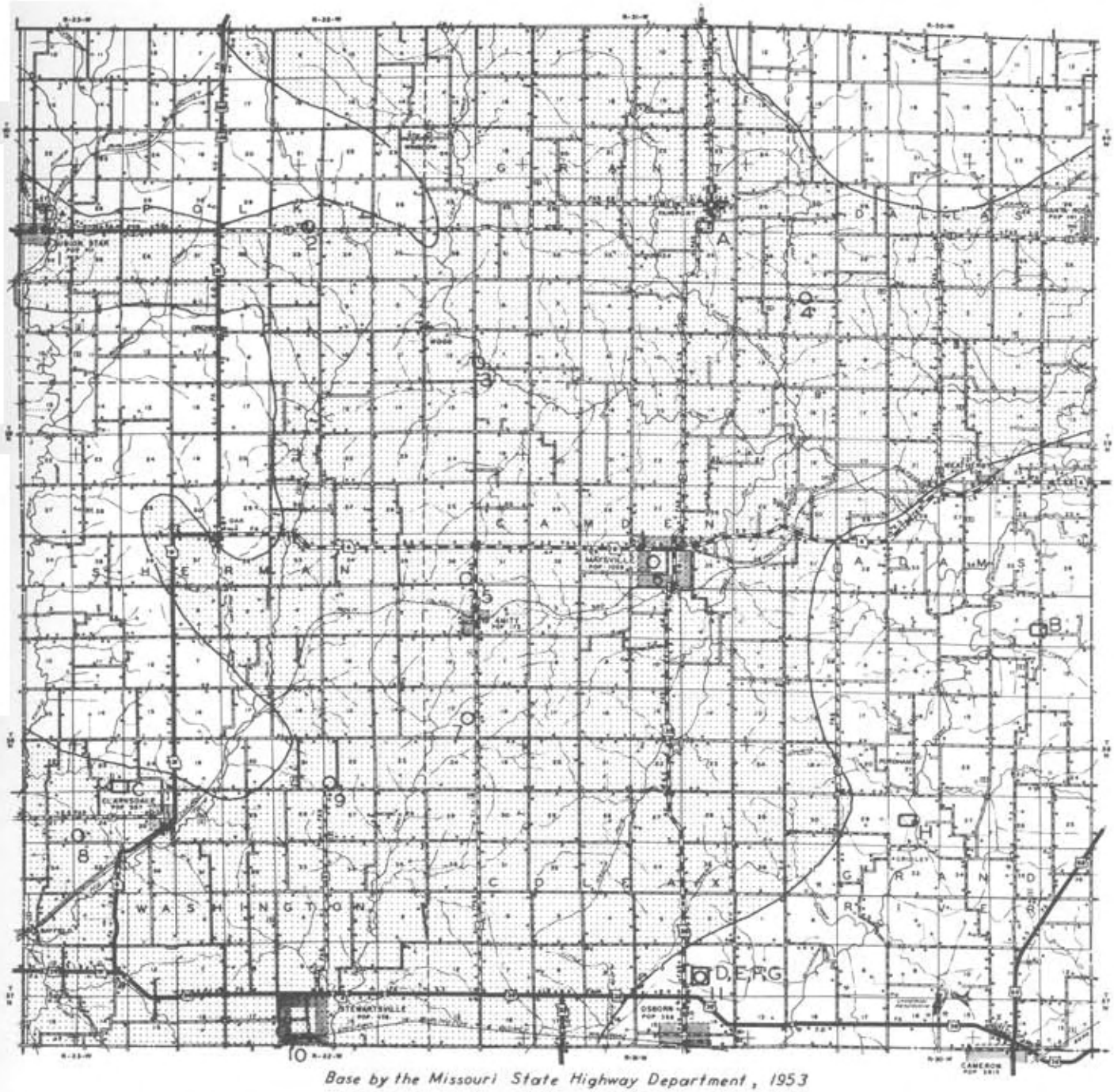
IRRIGATION WELLS.-- Included in this category are all high yield wells whether used by cities, by industries, or for irrigation. Plate 2 shows the area most favorable for the development of irrigation wells. Also shown are the locations of six wells which flowed. Although not everywhere is it shown as favorable on plate 2, the buried channel, the location of which is shown by plate 3, is worthy of exploration throughout its length. The deposition of clean sand and gravel is erratic within the channel and although the thick section of drift would seem to be favorable, yet in a very short horizontal distance the clay and silt content of the sands may become excessive.

With proper development, yields of 200-1000 gallons per minute may be obtained. Yields to be expected are continent upon several factors:

(1) The thickness of the sand and gravel beds.
(2) The size and sorting of the sand and gravel.
(3) The manner of construction and materials used, such as proper well screen, gravel pack, etc.
(4) Ability of the well driller to develop the full capacity of the water bearing sands.

Continued successful production is contingent upon:

(1) Re-charge rate of the water-bearing horizons.
(2) Quality of the screen and materials used.
(3) Subsequent well treatment such as acidizing.
(4) Avoidance of over-pumpage.



Base by the Missouri State Highway Department, 1953

LEGEND

Area most favorable

O_4 Location of wells in drift from which water was analyzed

□H Water sample analyzed from a "rock" well

—N—

MAP OF DE KALB COUNTY

SHOWING

AREA MOST FAVORABLE FOR THE DEVELOPMENT OF WELLS IN DRIFT

BY

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1957

MISSOURI GEOLOGICAL SURVEY
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ROLLA, MISSOURI

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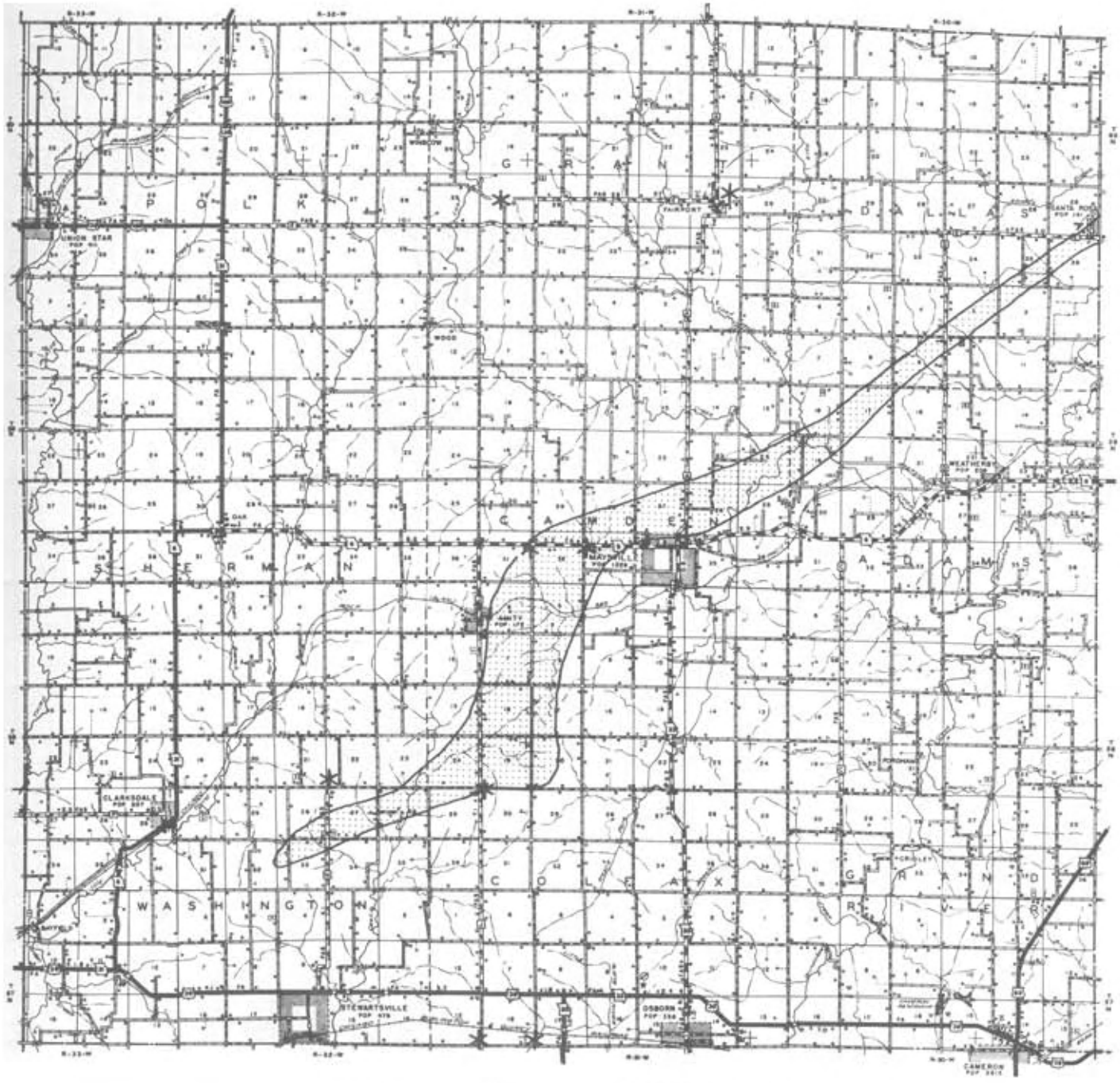
PLATE 1



Base by the Missouri State Highway Department, 1953

LEGEND

Drift filled valley

* *Test wells that flowed*

N

PLATE 2

MAP OF DE KALB COUNTY
SHOWING
DRIFT FILLED VALLEYS IN WHICH IRRIGATION WELLS POSSIBLY CAN BE DEVELOPED

BY
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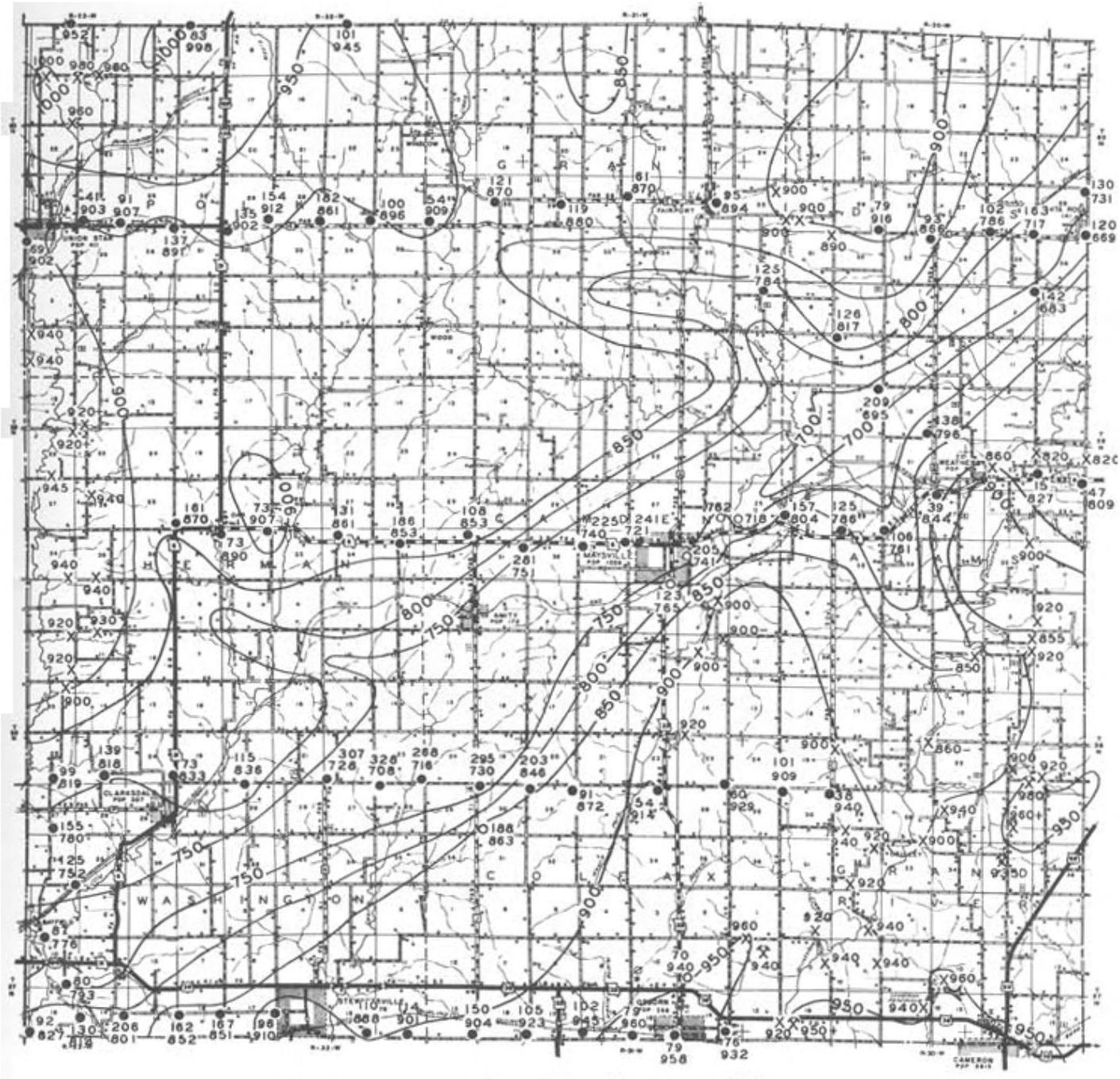

Base by the Missouri State Highway Department, 1953

LEGEND

- ●135 650 — *Test holes showing thickness in feet of drift and elevation of bedrock above sea level*
- o — *Water wells*
- X — *Bedrock Outcrops*
- ⚒ — *Mine or Quarry*
- 920 — *Indicates outcrop elevation*

N

PLATE 3

CONTOUR MAP
OF
DE KALB COUNTY
SHOWING
BEDROCK ELEVATIONS
BY
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W. B. RUSSELL
1957
MISSOURI GEOLOGICAL SURVEY
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THOMAS R. BEVERIDGE
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SUMMARY

Approximately 9,000 acres of DeKalb County are located within the area in which irrigation wells possibly can be developed. Nearly two-thirds of DeKalb County's area is suitably located for obtaining water sufficient for domestic needs from the glacial drift.

Questions concerning water problems for a specific location should be sent to the Missouri Geological Survey, Rolla, Missouri.